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Ecological Survey of the Vegetation of the Yurok Research Natural Area, California

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ABSTRACT

The Yurok Research Natural Area, located in northwestern California, protects nearly 150 acres of old-growth Redwood Forest (SAF Forest Type 232) for research purposes. This report provides a reconnaissance level ecological description of the vegetation.

Redwood Forest on the Yurok RNA supports very dense stands of old-growth timber averaging about 200 m^2ha^{-1} Basal Area -- among the most massive stands of coniferous trees known.

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INTRODUCTION

The Yurok Research Natural Area (Yurok RNA) is the sole Forest Service Research Natural Area representing typical old-growth Redwood (*Sequoia sempervirens*) vegetation in the central region of distribution of this type.

This report describes the composition and structure of the vegetation of the Yurok RNA, and provides a partial list of plant species found there.

Yurok RNA- Historical Background - Heavilin and Lynch (1977) describe the detailed history of the Yurok RNA. The RNA was purchased from private timber companies by the U.S. Forest Service during the Depression Years (mid-1930's). Following World War II, the nearly 1000 acre Redwood Experimental Forest (then called the Yurok EF) was established at the site. In 1976, the Yurok RNA was designated, carving out nearly 150 acres of former Experimental Forest that was not manipulated.

Other Redwood RNA's - There are presently only three designated Federal RNA's which preserve old-growth Redwood vegetation: *1)* Wheeler Creek RNA, Siskiyou National Forest, Curry County, Oregon is located at the northern-most geographic limit of Redwood, *2)* The Yurok RNA, described in this report, and *3)* Little Lost Man Creek RNA, within Redwood National Park (cf. Fed. Comm. RNA's 1968, Franklin *et al*. 1972, Franklin & Dyrness 1973). On the face of it, only three designated RNA's within this most productive of North American forest communities would seem inadequate. There are, however, many biological reserves of varying sizes which preserve old-growth Redwood forest and its associated variants and seral stages - these being located within Redwood National Park, various California State Parks, and on lands owned by the University of California

and the Nature Conservency. Taken together, these areas provide more than adequate protection of representative areas of Redwood vegetation throughout its geographic range, with one major exception: there is no designated preserve at the very southern geographic limit of Redwood forest in Monterey County, California.

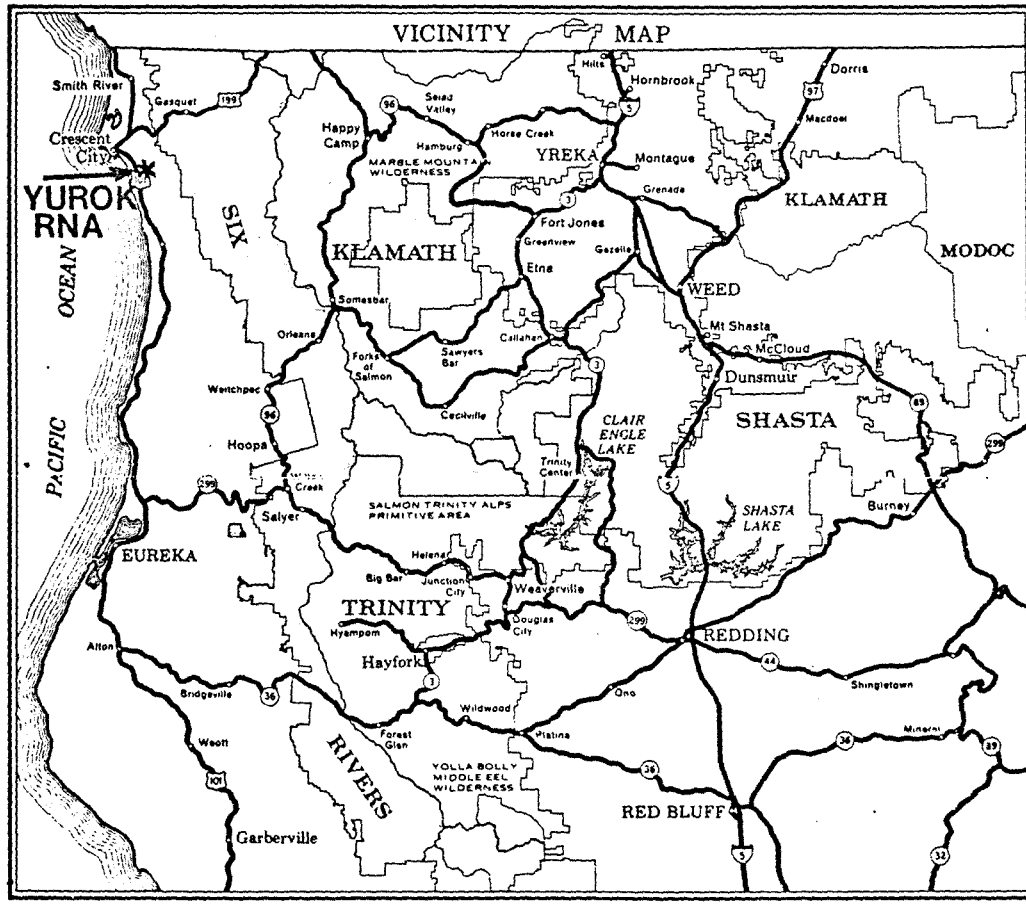
LOCATION

Yurok RNA encompasses approximately 150 acres, and is located on the coastal front of the North Coast Ranges in very northern California (Maps 1 & 2). The RNA is situated about 2 miles inland from the Pacific Ocean, near the mouth of the Klamath River in Del Norte County, California.

The RNA is located just off a major highway, Highway 101, and is easily accessible from this point. The RNA itself (Map 3) is without roads, save for the old cordovan road (which is now graveled) which parallels High Prarie Creek. However, most of the RNA can be easily reached by short hiking distances from similar gravel roads which provide access to the Redwood Experimental Forest. The RNA is within convenient distance of lodging and supply centers, located all along Highway 101. Electrical needs for any sort of field monitoring requiring power would have to be confined to the area immediately adjacent to the former Experimental Forest Headquarters. There is undisturbed old-growth Redwood Forest within 100 feet of the Headquarters building, which is presently not fully utilized, and is partially occupied by the National Park Service, Redwood National Park. The juxtiposition of the Yurok RNA with both logged and undisturbed areas in the Redwood Experimental Forest provide attractive research opportunities, particularly with regard to the effects of various logging methods on community recovery trends.

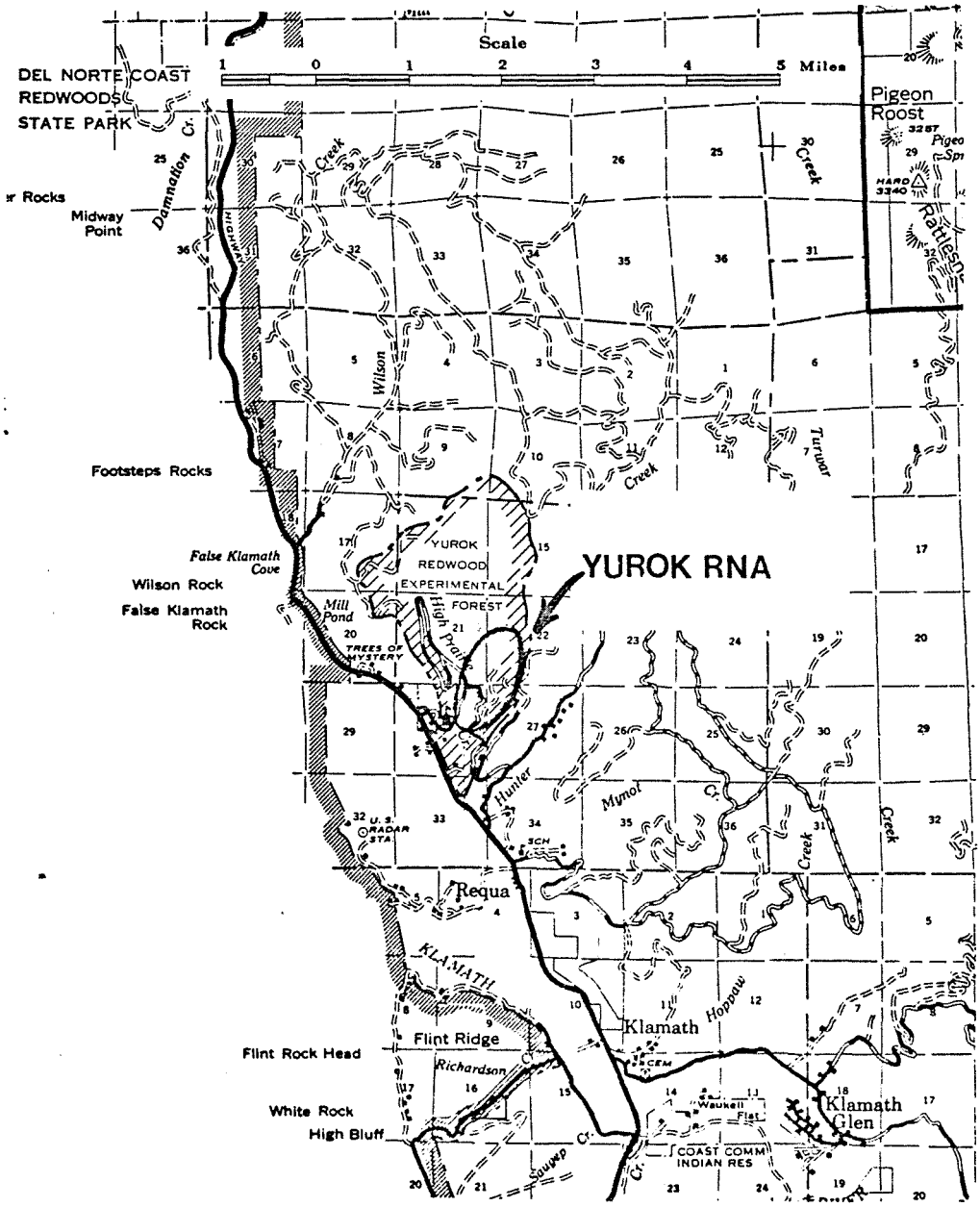
Map 1

Location of the Yurok RNA in Northern California

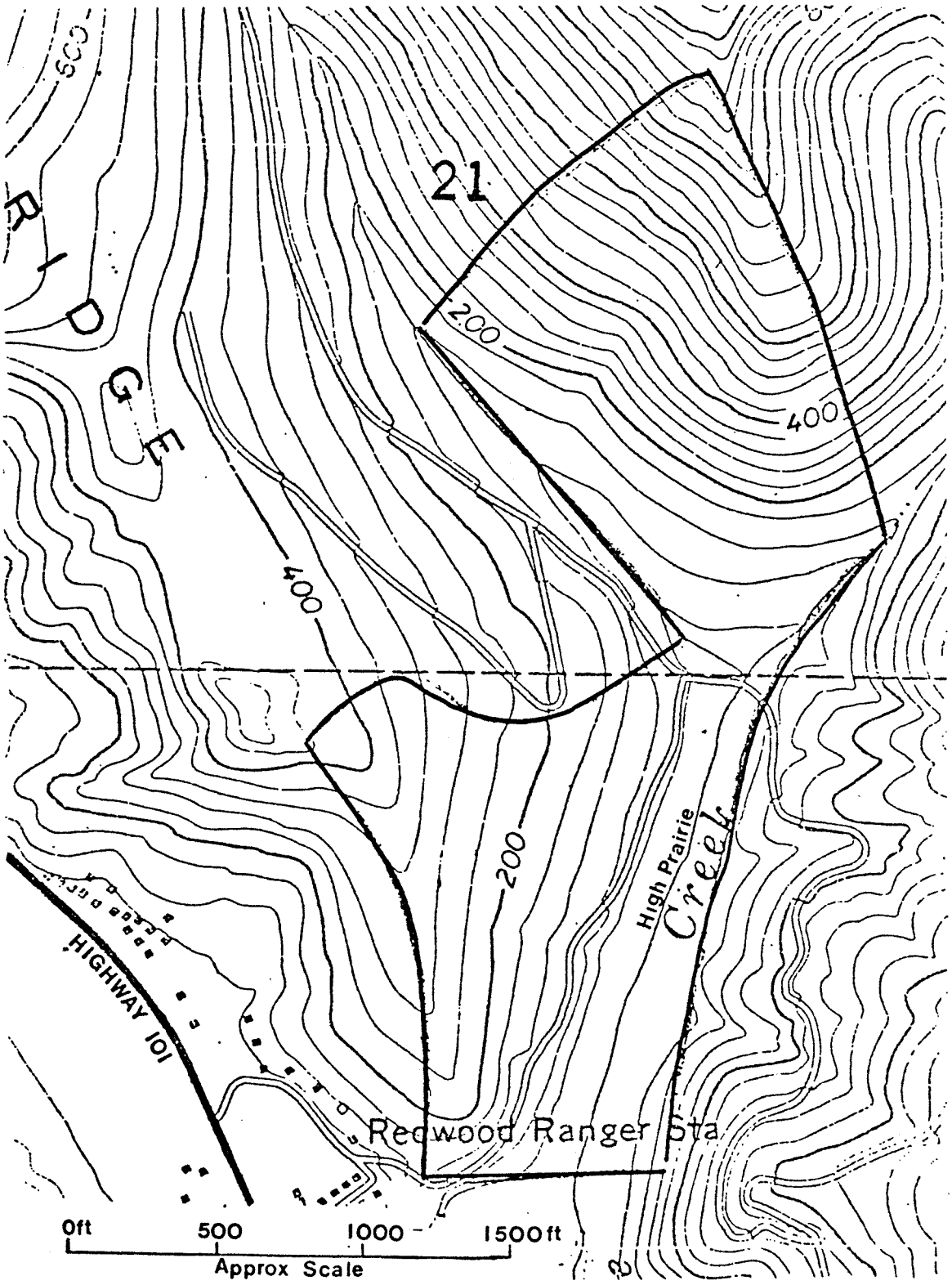


Map 2

Portion of the Six Rivers National Forest Administrative Map showing the location of the Yurok RNA and the adjacent Redwood Experimental Forest.



Map 3. Enlargement of portion of the Requa, CA 7½' USGS Quadrangle (1966 edition) showing the boundaries of the Yurok RNA [heavy line]. Scale is approximate.



GEOLOGY

The entire region including and surrounding the Yurok RNA is underlain by Mesozoic Rocks of the Franciscan Formation (Strand 1963, Page 1966), a complex of raw to slightly metamorphic sedimentary rocks. Since the general region of the Yurok RNA is so heavily vegetated, the geology has not been mapped at a small scale.

Rocks of the Franciscan Formation are generally soft and easily weathered, and thus soil development is good in the general region, with unweathered regolith at depths of about 3 meters in most areas. Rock outcrops are few due to the soft nature of the country rock and rapid weathering rates, but where they do occur, shallow soils and exposure combine to make such sites ecologically unique. No large rock outcrops occur within the Yurok RNA, although some very small exposures occur along High Prairie Creek.

HYDROLOGY

The watershed of High Prairie Creek, which includes portions of both Redwood Experimental Forest, and the Yurok RNA, is not gauged (Cal. DWR 1981). Nearby drainages, such as Wilson Creek, which are similar in size and vegetation, do have short (since 1977) gauging records. From my visual estimate, High Prairie Creek appears to be of a size that would support a mean discharge rate of $< \cong 20$ $ft^3 sec^{-1}$ (0.57 $m^3 sec^{-1}$)

CLIMATE

Temperature and precipitation records from the Redwood Experimental Forest and Yurok RNA are limited in duration. Weather data have been collected sporadically over the years by USFS personell, but no compilation of these data is available. However, since the climate of the North Coast

is fairly constant (varying with elevation and distance from the coast), several nearby recording stations with long-term weather records can serve to characterize the climate of the Yurok RNA. Table 1 and Figures 1-3 give climatic data from two nearby stations with similar vegetation: Klamath, about 2 miles south of the Yurok RNA and very similar in general location, and Crescent City, about 12 miles to the North. Both of these stations are typical of the superhumid conditions of the Redwood region of Northern California. Precipitation is well in excess of Potential Evapotranspiration (Pot E) in all but about a month or so in mid-summer. Thus, severe, productivity limiting drought is absent to negligible except for a short period, and during this short period stored soil-moisture can greatly supplement precipitation. Rainfall records do not show the sizable contribution from fog-drip, most abundant and important in the summer months, which can supplement precipitation by as much as 75 mm mo^{-1} (3 inch mo^{-1}) (Azevedo and Morgan 1974).

Temperatures in the general vicinity of the Yurok RNA are cool and generally constant. To be sure, low summer temperatures are likely to be nearly equally important in limiting forest productivity as is the short summer drought in this region.

Klamath, which is the recording station nearest Yurok RNA, has a mean annual temperatue of 52.7 °F (11.5 °C), and a mean annual precipitation of 87 inches (2211 mm). Figures 1 & 2 show climatic diagrams for Klamath and Crescent City (using method of Walter and Leith 1967). Figure 3 shows a water balance diagram for Crescent City (taken from Major 1977, calculated using Thornthwaite method). Estimated Pot E for Crescent City is 650 mm (26 inches), while Actual Evapotranspiration is about 544 mm (21 inches). Thus, summer drought for this station is very small, on the order of 106 mm (4 inches). By the Thornthwaite estimate, about 70% of the precipitation is in excess of Pot E, and thus

Table 1

Monthly precipitation and temperature means for Klamath and Crescent City (stations similar to the Yurok RNA).

	J	F	M	A	M	J	J	A	S	O	N	D	YR	
						Precipitation								
Crescent City	320	230	210	128	102	35	16	19	38	156	267	287	1808	mm
Klamath	442	326	284	135	108	36	7	11	44	190	253	370	2211	mm
						Temperature								
Crescent City	9.5	8.9	9.1	9.3	11.9	14.2	14.6	14.8	14.7	12.9	10.7	8.9	11.4	°C
Klamath	7.6	8.5	8.6	10.2	12.1	14.0	14.8	15.0	14.8	13.1	10.6	8.5	11.5	°C

Figures 1 & 2

Climatic diagrams for Klamath and Crescent City, plotted with the method of Walter and Leith (1967) where 10°C = 20 mm water.

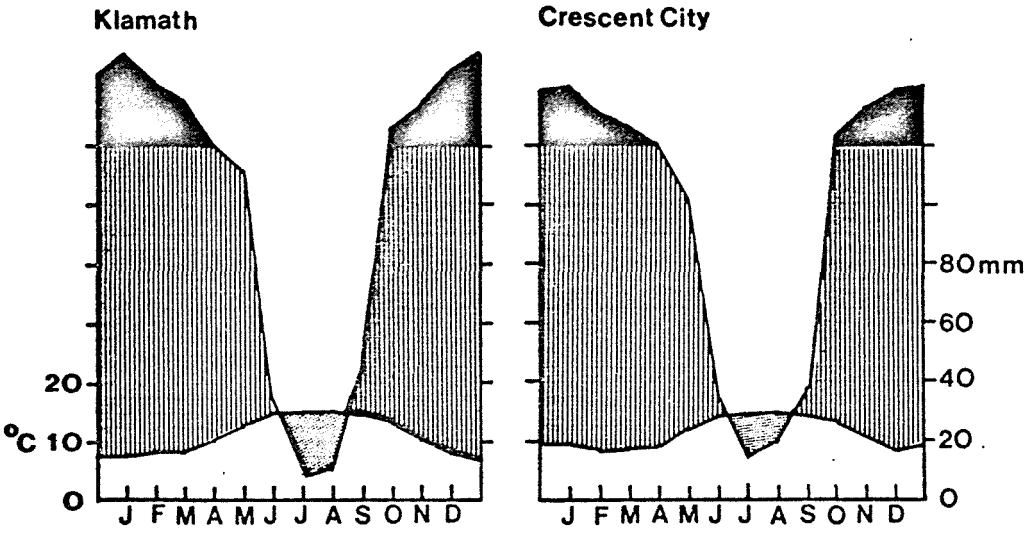
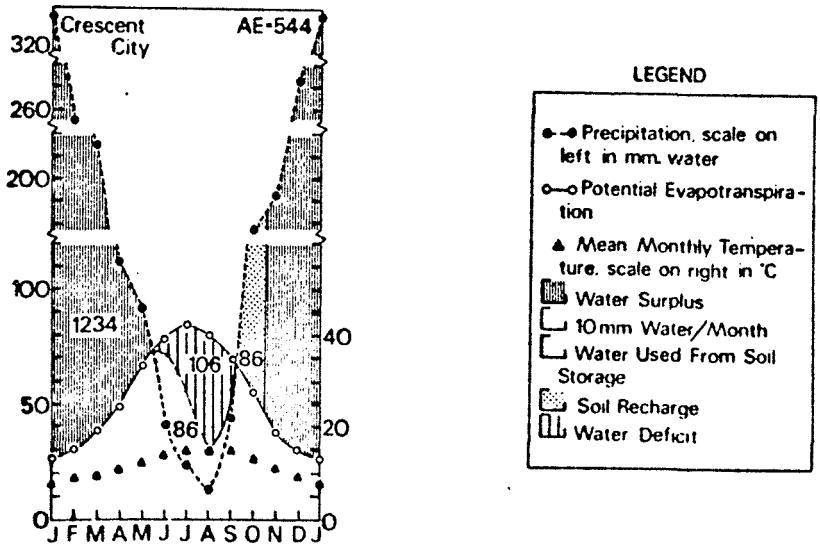


Figure 3

Water balance diagram using the method of Thornthwaite (taken from Major 1977) for Crescent City. Legend as shown.



run-off is high.

SOILS

The soils of the Yurok RNA and Redwood Experimental Forest were surveyed in detail by the Soil-Vegetation Survey (Colwell and DeLapp 1959). Soils of the RNA are generally deep (to 4 ft) sandy loams (clay ∿ 15%) of moderate fertility. Profile development is strong. The upland soils of the RNA have an organic rich A-horizon (OM ∿ 5-15%) which is most fertile and slightly acid (p*H* ∿ 5.5) and moderately deep (ca. 10-13 inches), while the deeper (12-18 inches) B-horizon is heavily leached, most infertile and acid. The upland soils of the RNA are generally Nitrogen and Phosphorus deficient, while excess Iron and Aluminum concentrations are found in some peda. Soils of the more gentle slopes along High Prairie Creek are generally more fertile and less acid than upland soils due to their alluvial nature.

Soil diversity is low on the RNA, with only two major soils being present: the Melbourne Series on upland sites, and an undescribed alluvial flat soil.

Excellent soil-vegetation maps are available for the general area both North and South of the Yurok RNA (see Colwell 1974). The most extensive coverage is near the mouth of the Eel River about 30 miles South, where very similar vegetation and climate occurs (Colwell *et al*. 1958a, 1958b, 1958c, DeLapp *et al*. 1961, DeLapp and Smith 1976).

Map 4 shows a portion of the soil-vegetation map of the Yurok RNA redrawn from Colwell and DeLapp (1959). Data on specific characteristics for the Redwood region soils can be found in Storie and Weislander (1952) and Durgin (1980)

Legend to Map 4. Soil-Vegetation Map of the Redwood Experimental Forest and Yurok RNA taken from Colwell and DeLapp (1959).

Soils

Soil Characteristics are characterized by a fraction system as follows:

Numerator = Soil Series

814 Melbourne Series
200 Undescribed alluvial soil series

Denominator = Soil Depth

1st digit	Map Symbol	Soil Depth in feet	Soil Description
	1	< 1 ft	Very shallow
	2	1-2 ft	Shallow
	3	2-3 ft	Moderately Shallow
	4	3-4 ft	Moderately Deep
	5	> 4 ft	Deep

2nd digit	Map Symbol	Percent Slope	Soil Description
	1	0-30%	Nonsteep
	2	30-50%	Steep
	3	50-70%	Very Steep
	4	>70%	Extremely Steep

Prefix S = Phase of soil with significantly more gravel and stones than normal for a series.

Vegetation

Site Quality for Douglas Fir

Site Class Symbol	Site Index
I	200
II	170
III	140

Species Composition

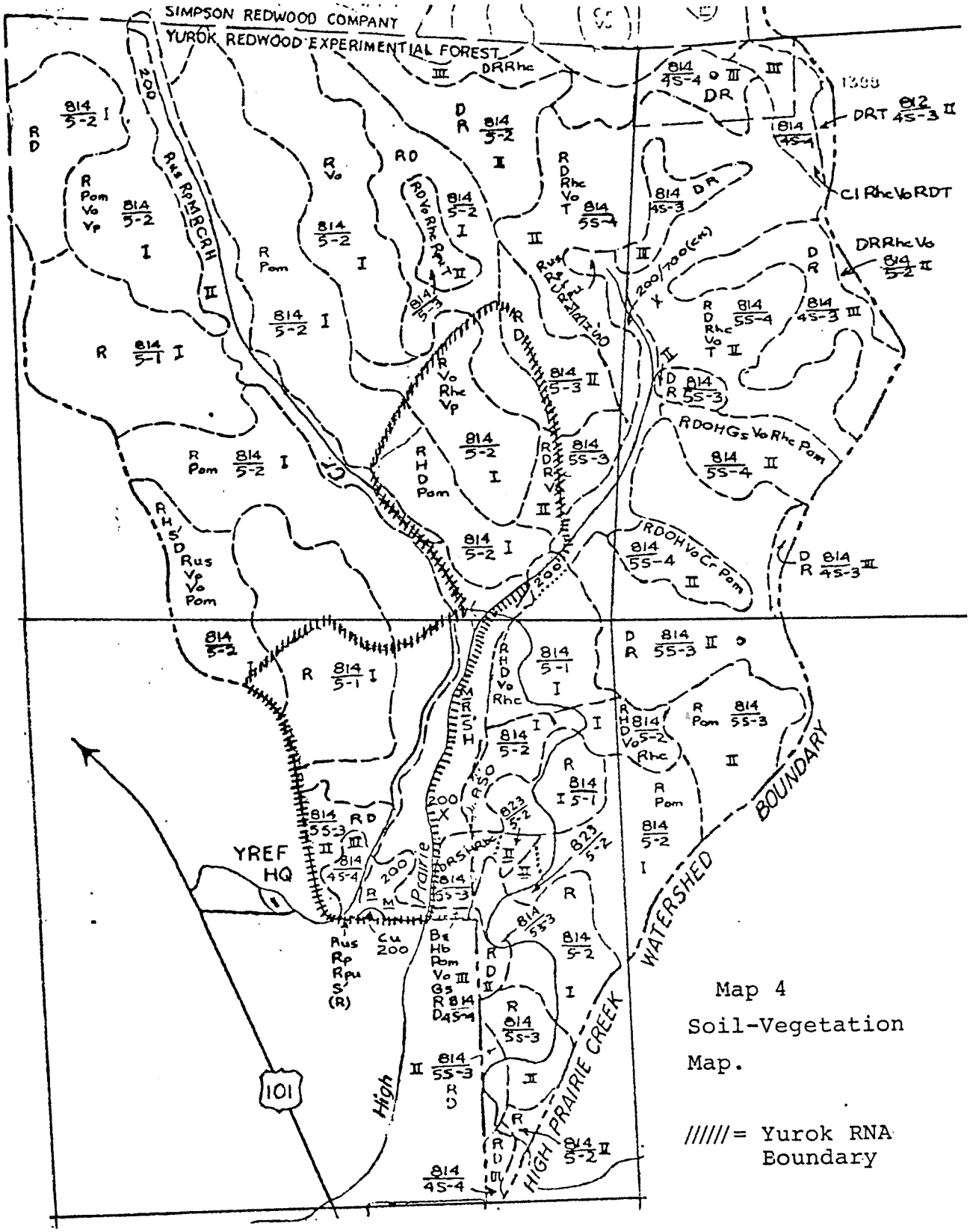
(next page)

Map Symbol	Taxon	Common Name
Bn	*Mahonia nervosa*	Oregon Grape
Cr	*Corylus cornuta californica*	California Hazelnut
Ct	*Ceanothus thrysiflorus*	Coast Blue-blossom
D	*Pseudotusga menziesii*	Douglas Fir
Gs	*Gaultheria shalon*	Salal
Hb	----------	Herbs
H	*Tsuga heterophylla*	Western Hemlock
L'	*Umbellularia californica*	California Bay
M	*Arbutus menziesii*	Madrone
M	*Acer macrophyllum*	Big-leaf Maple
O	*Chamaecyparis lawsoniana*	Port-Orford Cedar
Pom	*Polystichum munitum*	Sword Fern
Q	*Chrysolepis chrysophylla*	Giant Chinquipin
R	*Sequoia sempervirens*	Coast Redwood
R	*Alnus rubra*	Red Alder
Rch	*Rhododendron macrophyllum*	Coast Rhododendron
Rix	*Ribes sanguineum*	Red-flowered Currant
Rp	*Rubus parviflorus*	Thimbleberry
Rus	*Rubus spectabilis*	Salmonberry
Rv	*Rubus ursinus-vitifolius*	Blackberry
S'	*Picea sitchensis*	Sitka Spruce
Sx	*Salix lasiolepsis*	Arroyo Willow
T	*Lithocarpus densiflora*	Tan-bark Oak
Vo	*Vaccinium ovatum*	Evergreen Huckelberry
Vp	*Vaccinium parviflorum*	Red Huckelberry
Whm	*Whipplea modesta*	Modesty

As indicated on the soil-vegetation map, the total area of the two forest types on the RNA are:

Redwood Forest (SAF 232) ~ 120 acres

Alder-Maple Forest (SAF 221) ~ 30 acres



Map 4
Soil-Vegetation Map.

////// = Yurok RNA Boundary

Survey Methods

Because of the general lack of great spatial variability in the vegetation of the Yurok RNA, I elected to sample forest composition using the point-centered quarter method for basal area and density (Muller-Dombois and Ellenberg 1974). Ten points per transect were spaced at approximately 15 meter intervals (pacing estimates). A total of 10 transects were sampled. Along each transect a releve (stand survey, Mueller-Dombois and Ellenberg op. cit.) listing all species present and estimating their cover, was taken. Transects were placed so as to avoid entering or transecting areas that were heterogeneous in relation to the composition of the vegetation being sampled.

Yurok RNA Vegetation

Species Composition

Table 2 lists the species composition of the vegetation encountered on the 10 forest transects located in Redwood Forest. Additionally, 3 releves were sampled (without tree statistics) in riparian areas along High Prairie Creek. Of the 82 native plant species I observed on the Yurok RNA, only 36 (43%) were encountered in the 13 releves sampled. This indicates that only a proportion of the variation in the vegetation was included within the data taken.

The vegetation of the Yurok RNA can be divided into 2 habitat-types based on the data in Table 2:

SAF 232 *Sequoia sempervirens - Polystichum munitum* Habitat-Type

SAF 221 *Alnus rubra - Rubus spectabilis* Habitat-Type

Composition of these two habitat-types is as follows:

Table 2

Vegetation composition of the Yurok Research Natural Area.
The 10 numberd releves were taken on point-centered quarter transects measuring forest structure. The three releves designated by letters were observed along High Prairie Creek. ( ) designates nearby to releve site.
See Mueller-Dombois & Ellenberg for symbols (5 cover classes; + = present, low cover)
1 = 1-5% 2 = 5-25% 3 = 25-50% 4 = 50-75% 5 = > 75% cover and sampling methods.

Species	Releve 1	2	3	4	5	6	7	8	9	10	A	B	C
Trees													
Sequoia sempervirens	5	5	4	5	5	3	5	5	5	5		1	+
Pseusotsuga Menziesii	+				+	1			+	1			+
Tsuga heterophylla	1	+		+	+	+	1	2	1				(+)
Lithocarpus densiflora			+							+			
Acer macrophyllum			+							+	4	2	3
Alnus rubra	+		1							1	3	4	2
Chamaecyparis lawsoniana	+										+		+
Abies grandis			+								+	1	
Shrubs													
Vaccinium ovatum	+	4	2	3	3	2	3	2	1	+			
Rubus spectabilis	+	+	2						+	2	3	4	2
R. parviflorus	1	+	+		+			+		1	+	2	+
Corylus cornuta	1	+			2					1	+	1	+
Sambucus callicarpa	+				1					3	+	1	1
Vaccinium parviflorum				2	1		+	+					
Ribes sanguineum					+		1		+	2	+		1
Gaultheria shalon		1			1		+		+	1	1		+
Mahonia nervosa			+	+									
Menziesia ferruginea						+			+		+	+	1
Rhododendron macrophyllum	+					+				1		+	
Rubus procerus													
R. ursinus					+								
Salix lasiandra									+		2	3	2
Myrica californica			+								1	2	+
Acer circinatum											+		
Toxicodendron diversilobum radicans				+									
Herbs													
Polystichum munitum	1	2	1	3	1	1	1	+	3	1	+	+	+
Vancouveria planipetala	+	+	+	+	+	1	+	+	+	1	1		
Oxalis oregana	+				1	2	3	2	+				
Viola sempervirens	+	+					+	+	+				+
Dentaria californica cardiophylla	+						1	2	1				
Tolmia menziesii	+	+		+	1	1				1	1		
Chamaenerion angustifolia		+		+				+				2	+
Galium triflorum			+		+				+				
Asarum caudatum			+				+						
Sciolopis bigelovii							+	2	+		1	+	
Heirochloe occidentalis			1	1	2	+			+				
Equisteum laevigatum								+			+	2	2
Belchnum spicant									+		1	+	+
Polypodium scouleri								+			+	+	1
HABITAT TYPE	*Sequoia sempervirens-Polystichum munitum*										*Alnus rubra-Rubus spectabilis*		

Sequoia sempervirens-Polystichum munitum - This is the most common vegetation type on the Yurok RNA. It occurs on upland soils, and is only slightly variable in species composition. *Sequoia sempervirens* is clearly the dominant tree, with *Tsuga heterophylla* the only constant associate tree species. *Pseudotsuga menziesii* is found only occasionally in stands of this habitat-type, usually as outliers, or after disturbance such as fire (Veirs 1982) or windthrow (Zinke 1977). Other seral tree species can invade older stands of *S. sempervirens-P. minitum* vegetation only following disturbance which limits light competition and provides adequate mineral soil seedbed: *Alnus rubra, Abies grandis, Lithocarpus densiflora* and *Acer macrophyllum* are in this group. The composition of the forest canopy of this habitat-type is such that total canopy cover is on the order of 80-100% in most stands of this type. Generally, *Sequoia* is the canopy dominant, and associated tree species are suppressed individuals which do not generally penetrate the canopy, except ocassional, exceptionally vigorous and large individuals of *Pseudotsuga menziesii*.

The shrub understory of this habitat-type is well developed in some stands, with as many as 6-8 taxa participating, whereas some stands are mostly without dense shrub understory development: stands of this latter kind are often typified by sparse *Vaccinium ovatum*. In all of the stands sampled on the RNA, *V. ovatum* dominated the shrub understory most often, with *V. parviflorum, Gaultheria shalon* and *Ribes sanguineum* as important codominants. *Rubus spectabilis, R. parviflorus, Corylus cornuta californica* and *Sambucus callicarpa* are shrub species which can be found in disturbed sites (ie. windfalls) within this habitat-type. These same species are important components of seral vegetation units on Redwood sites in the general vicinity of the Redwood Experimental Forest-Yurok RBA (cf. Veirs, 1982; Muldavin *et al.* 1982). A few other shrub taxa were occassionally encountered within this type (cf. Table 2).

The herbaceous understory of the *Sequoia sempervirens-Polystichum munitum* Habitat Type is dominated by only a few species: *Polystichum munitum* is most important, along with *Vancouveria planipetala, Oxalis oregana, Viola sempervirens. Heirchloe occidentalis* is the only native grass which is commonly found within stands of this type.

Total shrub and herbaceous cover under the canopy of this forest type is often in excess of 80%, and some stands cover is certainly total. Shrub and herb patches within this forest exhibit a mosaic distribution. Where shrub cover is dominated by *Vaccinium ovatum*, the tendency is for fewer species of other shrubs and herbs to be present. Where dense shurb cover occurs, and *V. ovatum* is not predominant, a fairly rich herbaceous community develops. Often, usually under the denser phases of the tree canopy, small, open areas where few shrubs or herbs grow are found. Two species more typical of these patches are *Oxalis oregana* and *Chimaphila umbellata*. At such sites, dense *Sequoia* litter and duff is found.

Alnus rubra - Rubus spectabilis Habitat Type - This habitat-type is found along the alluvial soils adjacent to High Prairie Creek. The tree stratum is comprised by *Alnus rubra* and *Acer macrophyllum* in about equal proportions. *Chamaecyparis lawsoniana* is a subdominant, and most of the other conifer species can be found as ocassional individuals. The dense shrub understory of this habitat-type is dominated by deciduous species: *Rubus spectabilis, R. parviflorus, Sambucus callicarpa* and *Menzesia ferruginea*. Herbaceous cover is mostly dominated by *Polystichum munitum, Blechnum spicant, Equisetum laevigatum* and *Chamaenerion (Epilobium) angustifolium*. Other species characteristic of this vegetation are *Salix lasiopsis, Myrica californica, Polypodium scouleri* and some of the species listed in Appendix 1 which were not encountered on the releves sampled such as *Mimulus dentatus*. *Polypodium scouleri* and *P.*

glychrriza often grow epiphytically in dense moss on the trunks of *Acer macrophyllum*.

Redwood Forest Structure

Table 3 lists the Basal area and stem density data collected from the Yurok RNA. Total Basal Area for the 10 transects sampled exceeded 200 m^2 ha^{-1} in every case, with *Sequoia sempervirens* comprising 94% of the Total Basal Area. *Sequoia* averaged 231 m^2 ha^{-1}, with one stand exceeding 294 m^2 ha^{-1}. Stem density averaged about 200 stems ha^{-1}, with *Sequoia* comprising 23% of this value. Some transects had high densities of sapling and pole reproduction of seral tree species, and these artifically inflated the density values. Density of trees greater than 12 inches d.b.h. is only about 60 stems ha^{-1} in the *Sequoia sempervirens-Polystichum munitum* Habitat-type on the Yurok RNA.

The degree of variability in Basal Area was relatively low (Coefficient of Variation ≅ 20%) on the transects sampled: *Sequoia sempervirens* Basal Area variation was also low (Coefficient of Variation ≅ 25%).

The contribution to Total Basal Area by *Pseudotsuga menziesii* and *Tsuga heterophylla* was less than 10% in most stands, with the former species contributing about 15% in only one stand. Other tree species made only relatively minor contributions to Total Basal Area.

The Basal Area and stem density data reported herein are similar to values collected from a single 0.4 acre cruise plot located on the RNA (see Appendix 2). That plot recorded a Redwood Basal Area of 231.5 m^2 ha^{-1}, stem density of 22 stems ha^{-1}, and total wood volume of 730 m^3 (or, about 4,500 m^3 ha^{-1}); a very large biomass value!

This same cruise-plot recorded tree heights for Redwood, and the larger trees regularly exceeded 250 feet (75 m) in height!

Table 3

Basal Area and density for tree species sampled on the 10 point-centered quarter transects.

Plot	1	2	3	4	5	6	7	8	9	10	Mean ± S.D.
Species	Basal Area (m^2ha^{-1})										
Sequoia sempervirens	206	291	191	214	294	291	221	230	200	181	231 ± 44
Tsuga heterophylla	12	3		3	9	6			1	1	5.0 ± 4.2
Pseudotusga menziesii	4				3	9	16	3	21		9.3 ± 7.6
Alnus rubra	1										- - -
Chamaecyparis lawsoniana	3									4	3.5 -
Lithocarpus densiflora			13							12	12.5 -
Acer macrophyllum			4							10	7.2 -
STAND TOTALS											245 ± 40
	Stem Density (stems ha^{-1})										
Sequoia sempervirens	121	25	41	37	49	96	17	20	33	30	46.9 ± 34.3
Tsuga heterophylla	31	104		61	105	21			140	10	67.2 ± 49.6
Pseudotsuga menziesii	321				62	13	91	21	165		118.8 ± 116.3
Alnus rubra	104										- -
Chamaecyparis lawsoniana	31									105	68.0
Lithocarpus densiflora			116							26	71.0
Acer macrophyllum			3							21	12.0
STAND TOTALS											199.6 ± 164.1

Boe (1974) reported on the results of various silvicultural treatments applied to old-growth Redwood stands on the Redwood Experimental Forest. On two of his clearcuts, Total Volume was 3,416 and 4,008 m^3ha^{-1}; these values are quite similar to the single cruise-plot data cited above.

Fugimori (1972) reported data on a Redwood stand with Total Volume of 10,865 m^3ha^{-1}. But, as Fugimori speculates, this value is likely to be artifically high since the single cruise-plot data he used was from a plot selectively located in the densest part of the stand. Fugimori suggested a more realistic Total Volume for this plot of 5,500 m^3ha^{-1}. Thus, it seems that the volume of the Redwood stands on the Yurok RNA are among the largest reported standing volumes for Redwood vegetation anywhere in Northern California. The value of the Yurok RNA for comparison to managed Redwood stands is thus very obvious: the RNA represents the maximum standing crop that can be expected in this forest type. Fugimori (1972) also estimated total biomass of his Redwood plot, using several conversions from volume to mass. Fugimori estimated this same Redwood plot with about 5,500 m^3ha^{-1} had a tree biomass of about 2,337,000 kg ha^{-1}. Using Fugimori's conversion factors, the single 0.4 acre cruise-plot located on the Yurok RNA had a tree biomass of about 1,776,000 kg ha^{-1}. Westmann (1978) reported biomass values from Redwood stands near Ft. Bragg, in Mendocino County. His Redwood stands from slopes, which are clearly smaller in mass than Yurok RNA stands (personal observation), supported about 1,155,000 kg ha^{-1}. Westmann's alluvial flat stands supported nearly 3,190,000 kg ha^{-1}. The differences between the maximum tree biomass values reported by Fugimori (1972) and Westmann (1978) are probably due to errors in extrapolation from volume to mass inherent in Fugimori's conversions. Thus, I suspect strongly that the biomass of Yurok RNA stands is likely to fall in the upper range of the values reported by Westmann, since Westmann's alluvial flat sites are similar in total volume (personal estimate observation) to Yurok RNA stands.

Photo 1

Typical old-growth Redwood Forest on the Yurok RNA.

Photo 2

Alder-Maple Forest, along High Prairie Creek on the RNA.

Research Value of the Yurok RNA

Although there are now extensive tracts of Redwood Forest protected in National and State Parks in California, the Yurok RNA is still an invaluable research resource for the Redwood Forest type (cf. Roy 1980). The proximity of Yurok RNA and Redwood Experimental Forest provides a valuable control by which individual variables related to silvicultural treatment can be evaluated for both regeneration strategies and environmental effects of logging. As Waring and Major (1964) point out, the vegetation of the California Redwood region is a complex of community-types controlled primarily by soil and climatic variables. This vegetation complexity has in large part been responsible for the confusion regarding successional trends following logging disturbance (cf. Veirs 1976 vs. Zinke 1977). Recent work (Muldavin *et al.* 1982, Lehiham *et al* 1982) has shown the variance in seral stages and thus potential successional pathways in this forest type.

Flora of the Yurok RNA

Appendix 1 lists the plant species I observed on the Yurok RNA. My visit was made in the fall, and thus many species were past flowering and fruiting, and were likely missed in this survey. However, the flora of the RNA is not very diverse, and most of the woodland species were recognizable.

A total of 105 species were observed from the RNA and vicinity. Of these, 18 (17%) were introduced weeds. Many of the native species were confined to areas along roads, or in open recently logged sites nearby the RNA. The actual flora of the Redwood Forests of the Yurok RNA consists of only about half of the species recorded in Appendix 1.

Appendix 1

List of Species for the Yurok Research Natural Area, Del Norte County, California

The list of species observed in the Yurok RNA is presented in the taxonomic order of A California Flora *by P.A. Munz (1959). The appropriate page number in Munz's manual is provided for each species. This list must be considered incomplete, as the season of year during which the list was compiled was not optimum for floristic observations.*

SELAGINELLACEAE

Selaginella oregana D.C. Eaton p. 24
Creek banks along High Prairie Creek, and roadcuts.

EQUISETACEAE

Equisetum laevigatum A. Br. p. 27
High Prairie Creek, moist sites.

PTERIDACEAE

Pteridium aqualinium (L.) Kuhn p. 31
var. *pubescens* Underwood.
Open, disturbed sites, near Experimental Forest Headquarters.

Adiantum pedatum L. p. 38
var. *aleuticum* Rupr.
Moist, steep slopes or rocky sites, uncommon.

ASPIDIACEAE

Polystichum munitum (Kaulf) Presl. p. 40
Understory dominant throughout the RNA.

Dryopteris expansa (Presl.) Fraser-Jenkins & Jeremy p. 41
Frequent understory component throughout the RNA.

BLECHNACEAE

Blechnum spicant (L.) Roth p. 43
Frequent understory component, particularly along roadcuts, throughout the RNA.

POLYPODIACEAE

Polypodium glycyrrhiza D.C. Eaton p. 45
Frequent epiphyte on Acer macrophyllum, along High Prairie Creek.

P. scoulerii Hook. & Grev. p. 45
Epiphytic & terrestrial, common throughout the RNA.

PINACEAE

Abies grandis (Douglas) Lindley p. 49
Infrequent in Redwood Forest, not common or codominant.

Picea sitchensis (Bongard) Car. p. 56
Infrequent in Redwood Forest, mostly not codominant.

Tsuga heterophylla (Raf.) Sarg. p. 56
Frequent codominant in Redwood Forest, scattered.

Pseudotsuga menziesii (Mirab.) Franco p. 57
Infrequent, not codominant, not reproducing in RNA but common on disturbed or seral forest communities nearby.

TAXODIACEAE

Sequoia sempervirens (D. Don) Endl. p. 57
The most dominant organism of the RNA!.

CUPRESSACEAE

Thuja plicata Don. p. 59
A few individuals near the Experimental Forest Headquarters, cultivated?

LAURACEAE

Umbellularia californica (H&A) Nuttall p..77
Infrequent, former disturbed areas in seral forest, and as waifs in Redwood Forest.

RANUNCULACEAE

Actea rubra (Ait.) Willd. p. 81
ssp. *argentea* (Nuttall) Hulten
Uncommon, moist sites along High Prairie Creek.

Ranunculus ornithorhynchus Hooker. p. 96
Common along roadside in RNA, uncommon in Redwood Forest.

BERBERIDACEAE

Mahonia nervosa (Pursh) Nuttall p. 109
Infrequent understory component in Redwood Forest.

Achylis triphylla (Sm.) DC. p. 111
Uncommon in rocky sites in Redwood Forest, and along High Prairie Creek.

Vancouveria planipetala Calloni p. 112
Frequent in open sites with less dense understory, Redwood Forest.

OXALIDACEAE

Oxalis oregana Nuttall p. 148
Infrequent understory component in Redwood Forest.

VIOLACEAE

Viola sempervirens Greene p. 185
Infrequent understory component in Redwood Forest, most common along roadcuts.

BRASSICACEAE

Barbarea orthoceras Ledeb. p. 238
Moist roadside ditch near Experimental Forest Headquarters.

Dentaria californica Nutt. p. 244
ssp. *cardiophylla* (Greene) Detl.
Infrequent understory herb in Redwood Forest.

CARYOPHYLLACEAE

Stellaria media (L.) Vill. p. 275
Moist sites in Redwood Forest, becoming common in logged sites, and in lawn at Experimental Forest Headquarters.

Sagina apetala Aid. p. 277
Mossy or rocky open sites-banks, rocks etc.

PORTULACACEAE

Claytonia spathulata Dougl. ex. Hooker. p. 303
Moist sites, often along roadsides etc.

POLYGONACEAE

Rumex acetosella L. p. 356
Open, disturbed sites-logged forest and roadsides.

R. crispus L. p. 358
Open, disturbed sites in recently logged sites, along roads and skidtrails.

PLANTAGINACEAE

Plantago major L. p. 406
Frequent in disturbed sites, where wet.

P. lanceolata L. p. 408
Common in all disturbed sites about the RNA.

ERICACEAE

Rhododendron macrophyllum D. Don p. 412
Uncommon in undisturbed Redwood Forest, most common in seral forest openings, throughout the RNA.

Menzesia ferruginea Sm. p. 413
Uncommon shrub in understory of Redwood Forest.

Gaultheria shallon Pursh. p. 415
Common understory component of Redwood Forest, rapidly invading into seral forest.

Vaccinium ovatum Pursh. p. 430
Codominant of understory of Redwood Forest throughout the RNA.

V. parviflorum Sm. p. 431
Infrequent shrub in understory of Redwood Forest.

PYROLACEAE

Moneses uniflora (L.) Gray p. 434
var. *reticulata* (Nuttall) Blake
Mossy banks and logs, throughout the RNA.

Chimaphila umbellata (L.) Baton
var. *occidentalis* (Rydberg) Blake
Open, less dense understory of Redwood Forest, most common in seral openings.

POLEMONIACEAE

Navarretia squarrosa (Esch.) H&A. p. 505
Uncommon in recently disturbed and logged areas about the RNA.

SCROPHULARIACEAE

Mimulus dentatus Nuttall ex Benth. p. 611
Along High Prairie Creek.

Scrophularia californica Cham. & Schlect. p. 642
Infrequent in disturbed areas about the RNA.

LAMIACEAE

Stachys chamissonis Bentham. p. 699
Frequent in moist sites, throughout the RNA.

Satureja douglasii (Benth) Briq. p. 708
Infrequent understory component of Redwood Forest.

SAXIFRAGACEAE

Tolmia menziesii (Pursh) T&G. p. 739
Infrequent understory herb in Redwood Forest throughout the RNA.

Tellima grandiflora (Pursh) Douglas p. 739
Frequent understory herb in Redwood Forest, scattered in the RNA.

HYDRANGEACEAE

Whipplea modesta Torrey p. 745
Infrequent understory component in Redwood Forest, most common in seral openings.

GROSSULARIACEAE

Ribes sanguineum Pursh. p. 749
Infrequent shrub in understory of Alder-Maple Forest along High Prarie Creek.

ROSACEAE

Alchemilla occidentalis Nuttall p. 777
Common in disturbed sites near Experimental Forest Headquarters.

Rubus procerus P.J. Muell p. 784
Uncommon, one clone near Experimental Forest Headquarters.

R. ursinus Cham. & Schlecht. p. 784
Frequent in disturbed sites throughout the RNA.

R. spectabilis Pursh. p. 785
Common understory component throughout the RNA.

R. parviflorus Nuttall p. 786
var. *velutinus* (H&A) Greene
Common understory component throughout the RNA.

BETULACEAE

Corylus cornuta Nach. p. 899
var. *californica* (A.DC.)Sharp
Infrequent shrub in openings, Redwood Forest.

Alnus oregana Nuttall p. 900
Common in disturbed sites and along High Prairie Creek.

FAGACEAE

Chrysolepis chrysophylla (Douglas ex Hooker) Hjelmquist p. 901
Infrequent tree in seral openings in Redwood Forest.

Lithocarpus densiflora (H&A) Rech. p. 902
Frequent but minor component of Redwood Forest throughout the RNA.

MYRICACEAE

Myrica californica Cham. & Schlect. p. 908
Rare understory component of Redwood forest, most common in seral forest openings.

SALICACEAE

Salix lasiandra Bentham p. 912
Uncommon in logged forest near the RNA, and along High Prairie Creek.

URTICACEAE

Urtica californica Greene p. 921
Frequent in colonies along High Prairie Creek.

ONAGRACEAE

Chamaenerion angustifolia (L.) Scop. p. 928
Common in wet areas, throughout the RNA.

Epilobium watsonii Barb. p. 933
var. *franciscanum* (Barb.(Jeps.
Frequent in wet sites, as along roadside ditches and High Prairie Creek.

ARISTOLOCIACEAE

Asarum cuadatum Lindl. p. 965
Frequent understory component of Redwood Forest throuthout the RNA.

RHAMNACEAE

Rhamnus purshiana DC. p. 973
Frequent in seral Redwood Forest openings, and as an understory dominant in Alder-Maple forest.

Ceanothus thrysiflorus Esch. p. 979
Uncommon in disturbed areas, as in old logging areas near the RNA.

LORANTHACEAE

Arceuthobium campylopodium Engelm. p. 990
forma *abientinum* (Engelm.) Gill
Observed on one *Abies grandis* individual. Note: other forma of this taxon are to be expected on the other conifer taxa.

ACERACEAE

Acer circinatum Pursh p. 996
Infrequent understory component of Redwood Forest throughout the RNA.

A. macrophyllum Pursh p. 996
Common tree along High Prairie Creek, and in seral openings in Redwood Forest.

ANACARDIACEAE

Toxicodendron diversilobum (T&G) Greene p. 998
forma *radicans* McNair
Infrequent vine in trees throughout the RNA.

APIACEAE

Hydrocotyle ranunculoides L. p. 1003
Frequent in wet sites along roadcuts near the RNA.

Oenanthe sarmentosa Presl. p. 1009
Infrequent along High Prairie Creek.

Hercleum lanatum Michx. p. 1026
Infrequent in open sites, grassland and along roadsides etc., near the RNA.

RUBIACEAE

Galium triflorum Michaux. p. 1040
Frequent understory herb in Redwood Forest.

CAPRIFOLIACEAE

Sambucus callicarpa Greene p. 1047
Dominant shrub in understory of Alder-Maple Forest along High Prairie Creek, and invading seral openings in Redwood Forest throughout the RNA.

DIPSACACEAE

Dipsacus fullonum L. p. 1057
Infrequent in open grassland and roadsides adjacent to the Experimental Forest Headquarters.

CUCURBITACEAE

Marah oreganus (T&G) Howell p. 1059
Infrequent in open sites near Experimental Forest Headquarters.

ASTERACEAE

Bellis perennis L. p. 1192
Lawn at Experimental Forest Headquarters, and invading along roadcut nearby.

Conyza canadensis (L.) Cronq. p. 1224
Recently disturbed or logged sites adjacent to the RNA.

Baccharis pillularis DC. p. 1226
ssp. *consanguinea* (DC.) C.B. Wolf
Seedlings observed in recently logged areas adjacent to the RNA, but no mature individuals present.

Erictites arguta (A. Rich) DC. p. 1254
Established in open sites, along roadcuts etc., throughout the RNA.

Gnaphalium japonicum Thunb. p. 1259
Seral communities along roads, and recently logged areas adjacent to the RNA.

Cirsium vulgare (Saiv). Terr. p. 1276
Disturbed areas adjacent to the RNA.

Hypocheris radicata L. p. 1302
Roadcuts adjacent to and within the RNA.

Onopordum acanthium L. supplement p. 165
Recently logged areas adjacent to the RNA.

LILIACEAE

Mianthemum dilitatum L. p. 1331
Infrequent understory herb in Redwood forest, lower elevations in the RNA.

Disporum smithii (Hook.) Piper p. 1332
Infrequent understory herb in Redwood Forest throughout the RNA.

Scoliopus bigelovii Torr. p. 1333
Uncommon in dense Redwood Forest adjacent to High Prairie Creek.

Trillium ovatum Pursh p. 1335
One colony seen along High Prairie Creek.

IRIDACEAE

Iris douglasii Herb. p. 1391
Frequent in open sites adjacent to the RNA, infrequent in Redwood Forest within the RNA.

ORCHIDACEAE

Piperia sp. pp. 1396 ff.
A few withered leaves of this orchid were seen in Redwood Forest.

Goodyeria oblongifolia Raf. p 1399
Infrequent in open to semi-dense Redwood Forest.

Calypso bulbosa (L.) Oakes p. 1399
Infrequent in dense Redwood Forest.

JUNCACEAE

Juncus effusus L. p. 1404
var. *pacificus* Fern. & Wieg.
Infrequent in moist sites in open areas adjacent to the RNA.

J. buffonis L. p. 1405
Frequent in muddy sites, as along roads and in logged areas adjacent to the RNA.

Luzula subsessilis (Wats.) Benth 1413
Infrequent in semi-dense Redwood Forest throughout the RNA.

CYPERACEAE

Carex obnupta Bailey p. 1461
Roadside ditch near the Experimental Forest Headquarters.

POACEAE

Festuca occidentalis Hook. p. 1478
Infrequent in open sites adjacent to the RNA.

Poa pratensis L. p. 1485
Frequent in open or distrubed sites throughout and adjacent to the RNA.

Deschampsia elongata (Hook.) Munro ex Benth. p. 1513
Frequent on mossy logs and banks throughout the RNA.

Holcus mollis L. p. 1515
Frequent in distrubed areas adjacent to the RNA.

Hierochloe occidentalis Buckl. p. 1541
Common understory herb in Redwood Forest throughout the RNA.

Anthoxanthum odoratum L. p. 1541
Common in open meadows and roadsides adjacent to the RNA.

Appendix 2

Summary of original cruise-plot data from a single 0.4 acre plot located on the Yurok RNA.

Species	DBH (in.)	Total Height (feet)	Merchantable Height (feet)	Crown[1] Class	Tree[2] Vigor	Crown[3] %
Redwood	76.6	276	240	CD	F	50
"	94.2	282	246	CD	F	50
"	82.3	---	240	CD	P	40
"	69.6	245	235	CD	F	50
"	9.6	---	---	S	G	40
"	66.1	---	180	CD	G	50
"	10.2	47	---	S	F	40
"	9.6	58	---	S	G	65
"	28.6	75	60	I	G	50
"	108.1	---	260	D	F	40
"	51.1	---	140	I	F	40
"	12.1	---	---	S	P	30
"	12.5	---	---	S	P	40
"	6.8	---	---	S	P	20
"	63.0	---	220	CD	F	40
"	30.3	---	40	S	F	30
"	80.2	---	200	I	F	40
"	27.5	---	20	S	F	60
"	89.9	---	180	I	F	50
"	53.9	246	194	I	G	60
"	15.1	---	---	S	P	50
"	65.8	---	180	CD	F	50

[1] D = Dominant
CD = Codominant
I = Intermediate
S = Supressed

[2] G = Good
F = Fair
P = Poor

[3] Percent of total tree crown occupies

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